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## FINAL TECHNICAL REPORT

Title: **Mesoscale Eddies and Fronts**  
Dates: 1 January 1989 - 31 January 1991  
Duration: 2 years and 1 month  
Amount: \$190,060  
Office of Naval Research nbr.: N00014-89-J-1574  
Florida State University nbr.: 27-1368-603  
Dartmouth College nbr.: 536-570

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### Summary:

The objectives of this grant comprised investigations of oceanic geostrophic turbulence and other mesoscale processes related to eddies and fronts, a numerical study of internal tides, and the organization of an international colloquium on oceanic vortices. All these objectives have been successfully achieved. The PI's two graduate students at Florida State University (E.G. Pavia and B. Tang) obtained their doctorates. Some work was also accomplished during the visits of Dr. Eric Chassignet (now at U. Miami) and Ms. Vigdis Tverberg (U. of Bergen, Norway). (These visits were mostly supported by other sources.)

The P.I. then relocated to Dartmouth College to which the grant was sub-contracted. There two new graduate students were hired, both being US citizens (Randall Villeneuve and Gordon Newhard). These students are continuing the research where the previous students left. Also, in May 1990, a Fifth Colloquium on the Modeling of Oceanic Vortices was held at Dartmouth College. While ONR funds supported the travel of a few key participants, other local sources were made available, and the majority of participants supported their travel with their respective research grants. A total of 57 participants, from 10 different countries, were present.

The scientific results of the project are best described by the abstracts of the publications acknowledging the support of the grant. These are:

### Publications:

#### 1) Appeared:

1. Cushman-Roisin, B., 1989: On the role of filamentation in the merging of anticyclonic lenses. J. Phys. Oceanogr., 19, 253-258.
2. Cushman-Roisin, B., V. Tverberg, and E.G. Pavia, 1989: Resonance of internal waves in fjords: A finite-difference model. J. Mar. Res., 47, 547-567.
3. Cushman-Roisin, B., and B. Tang, 1989: Geostrophic regimes and geostrophic turbulence beyond the radius of deformation. Elsevier Oceanogr. Ser., 50, 51-74.

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4. Cushman-Roisin, B., and B. Tang, 1990: Geostrophic turbulence and emergence of eddies beyond the radius of deformation. J. Phys. Oceanogr., 20, 97-113.
5. Cushman-Roisin, B., E.P. Chassignet, and B. Tang, 1990: Westward motion of mesoscale eddies. J. Phys. Oceanogr., 20, 758-768.
6. Tang, B., 1990: Fluctuating flow through straits of variable depth. J. Phys. Oceanogr., 20, 1077-1086.
7. Pavia, E.G., and B. Cushman-Roisin, 1990: Merging of frontal eddies. J. Phys. Oceanogr., 20, 1886-1906.
8. Cushman-Roisin, B., 1990: Modelling of oceanic vortices (Meeting report). Trans. Amer. Geophys. U., 71, 1065-1066.

2) In Press:

9. Chassignet, E.P., and B. Cushman-Roisin, 1991: On the influence of a lower layer on the propagation of nonlinear oceanic eddies. J. Phys. Oceanogr., to appear.
10. Panchang, V.G., G. Wei, B. Cushman-Roisin, and B.R. Pearce, 1991: Solution of the mild-slope wave problem by iteration. Appl. Ocean. Res., to appear.

3) Submitted:

11. Tverberg, V., B. Cushman-Roisin, and H. Svendsen, 1991: Modeling of internal tides in fjords. J. Mar. Res., favorably reviewed.
12. Cushman-Roisin, B., G.G. Sutyrin, and B. Tang, 1991: Two-layer geostrophic dynamics. Part I: Governing equations. J. Phys. Oceanogr., submitted.
13. Tang, B., and B. Cushman-Roisin, 1991: Two-layer geostrophic dynamics. Part II: Geostrophic turbulence. J. Phys. Oceanogr., submitted.



Statement "A" per telecon David Evans  
ONR/Code 1122ML.

VHG

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